



# Newsletter

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## Director's Note

I started my scientific career as a limnologist, one who studies fresh waters. Initially drawn to lakes, my interests moved shoreward and beyond into the watersheds that help to determine the character of the lakes they feed. With my research leading me from lakes to adjacent streams and forests, and then to changes in atmospheric chemistry triggered by human activity, my academic nametag evolved to ecologist and now to ecosystem ecologist.

This issue describes work by IES scientists to understand what lies behind the very obvious differences among lakes. You will also learn of our unique course in ecosystem ecology designed to broaden the horizons of young scientists from the U.S. and abroad. Finally, news from our education program describes new initiatives to share what we know with a regional audience.

Exciting research, shaping a scientific discipline, sharing our knowledge - this is what IES is all about.

The *IES Newsletter* is published by the Institute of Ecosystem Studies, located at the Mary Flagler Cary Arboretum in Millbrook, New York.

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Steve Carpenter

*Tuesday Lake shown here is an example of a brown-water ecosystem. This lake is located near the Wisconsin-Michigan border and has been the site of lake research by IES scientists since 1988.*

## The Color of Water

What color is water? Not all water is the same color, as even the most casual observers of lakes, ponds, streams will agree. Clear water that often appears blue from a distance is the most pleasing to the human eye — fabled clear waters like Lake Tahoe and Crater Lake are prized for their beauty and purity. The Hudson River presents a different impression because its waters hold high concentrations of silt, and consequently are muddy brown. And then there is green: in lakes and ponds choked with algae, the photosynthetic pigments of these microscopic plants selectively absorb red and blue light so that the human eye sees just the remaining green light. Finally, it is not uncommon to find lakes and streams that appear brown or even black — something between tea- and coffee-colored — because they contain high concentrations of dissolved organic compounds that come from the decomposition of upland and wetland plants. Brown water lakes are quite common especially in areas like the Adirondack Mountains of New York.

These different colored waters indicate differences in basic functioning of aquatic ecosystems. IES scientists are investigating what factors control the color of lake water, specifically asking what causes lakes to have blue, green, or brown water, and how do lakes change? The scientists also are concerned with how to manage “undesirable” lake conditions; for example, is it possible to make a green lake, teeming with algae, turn brown? Or, even better, blue?

*by Michael Pace*

The addition of nutrients in the form of nitrogen and phosphorus has long been known to determine whether a lake is blue or green. Just as fertilizing a lawn makes grass green, increasing the input of nitrogen and phosphorus to lakes increases the concentration of algae in the water column and enhances the growth of rooted plants that live in shallow water. This greening of the waters is a common problem that is often related to human development in the watershed. Even Lake Tahoe has become greener over the last few decades because of development in the basin that has led to increased nutrient inputs.

The obvious solution to this problem is to turn off the tap of nutrient inputs. Managing such a change, however, can often be difficult or even practically impossible. Are there alternatives to reducing nutrients? IES scientists Drs. Michael Pace and Jonathan Cole have participated in a series of whole-lake experimental manipulations designed to test if differences in fish populations in lakes can encourage population growth of specific herbivores that are particularly good algal grazers. These experiments tested the idea that certain fish at the top of the food web can limit by predation the small fish and invertebrates that in turn prey on herbivores. When their predators are reduced, the most effective herbivores are thereby favored and have the potential to control algae. The lake experiments supported this idea. When largemouth bass were present and the investigators added nutrients, the lakes did not turn green. In the

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## The Color of Water, from page 1

absence of largemouth bass, however, lakes became enriched with algae. The conclusion? Lakes turn green because of nutrients, but it is possible to manage food webs in lakes using fish to help control excess plant growth. This research thus provides a tool for managers who wish to limit phytoplankton in green lakes, especially when nutrient reductions or removals are difficult.

There are also many reasons to be interested in and concerned about brown water lakes. Although brown water lakes typically are mildly acidic, rain that is polluted with sulfuric and nitric acids can make these lakes so acidic that the compounds that give the lakes their brown color coagulate and precipitate. Under these conditions, the lakes become highly acidic and clear. The clarity of the water exposes the aquatic organisms to harmful ultraviolet light, and since the inhabitants of brown water lakes may be poorly adapted to this stress, local population extinctions may result.

Another concern is mercury pollution and the concentration of this toxin in fish tissues. Brown water lakes tend to have fish with greater mercury contamination, a condition

that is true even for remote wilderness areas of the Adirondack Mountains. The causes of this problem are complex, but are related to the deposition of mercury from air pollution and a greater tendency for mercury to increase in concentration, a process called "biomagnification", as it moves through the food web. In the watersheds of brown lakes, perhaps this process is a result of the same chemical conditions in the soil and water that make the water brown.

IES scientists Pace and Dr. Charles Canham currently are doing research on brown and blue lakes in the Adirondack Park region of New York. The goal of this project is to determine how landscape features and lake conditions interact to determine water color. Their study involves over 500 watersheds that have been carefully mapped by the Adirondack Park Agency using aerial photography and satellite imagery. A computer model has been developed that uses the data on land cover to predict the loading (input) of dissolved organic matter to lakes as well as the processing and losses of this material within lakes.

This work had led to new knowledge about the controls of brown and blue lake color....

for example, wetlands produce more dissolved organic matter per unit than do upland forests. Nevertheless, upland forest areas are still important sources of organic matter to lakes because they are the dominant land cover type in most watersheds. Thus, small lakes in big watersheds can have high dissolved organic matter and be brown in color even though there may be few wetlands, because the upland forests produce sufficient organic matter to color the water. The modeling approach developed in this study also provides a tool for managers of large areas like the Adirondack Mountains to assess how scenarios of development or climate change might have an impact on water resources such as lakes.

The three dominant colors of freshwaters – blue, green and brown – are important ecosystem indicators. IES scientists are discovering how these conditions arise and are maintained, and their research findings are providing new ways of thinking about lakes and their watersheds, as well as new tools for managers charged with protection of vital water resources.

## Fundamentals of Ecosystem Ecology Course

Science is built on a foundation of exactness. In the laboratory and in the field, scientists pay close attention to the accuracy and precision of their methods. But scientific language is not as easy to control. It is constantly evolving, incorporating new terms and concepts as discoveries are made and sub-disciplines are born.

Such is the case with the field of ecology. When the term "ecology" was coined in 1866, it was simply defined as the study of homes or dwellings (of organisms). But as the field has grown, this simple definition has given way to a succession of others (no pun intended).

A bare-bones modern definition of ecology is the study of the living and non-living components of the environment interacting in a definable space. There are two problems with this definition. First, it doesn't make clear what phenomena are being studied. Consider for example: an ecological study of you and your kitchen sink interacting. What would make this within the realm of ecology? Second, the idea of a "definable space" has for many excluded systems that are very large, like whole ecosystems or the entire planet.

In the early 1990s, Institute of Ecosystem Studies ecologists drafted a new and more explicit definition of ecology, making their own contribution to the evolving language of their discipline. The IES definition states that ecology, is "The scientific study of the processes influencing the distribution and abundance of organisms, the interactions among organisms, and the interactions between organisms and the transformation and flux of energy and matter."

The IES definition clearly delineates the types of processes and interactions ecologists study, and is readily applied to systems of all sizes. So—you and your kitchen sink are out unless they relate to the phenomena mentioned, but ecosystems in all their glory are in.

The IES definition of ecology stands out from the norm. Surprisingly, many students of ecology are still reading textbooks, and taking courses, where ecosystems are virtually absent

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Photographed left to right: Olga Barbosa Prieto, Aaron Moore, Dr. Gary Lovett, Isabel Ashton, Banning Starr, Ben Shelton, David Bostock, Bryand Brown, Windsor Lowe, Andrea Huberty, Alan Ellsworth, Jessica Hines, Emily MacFadyen, Roxanne Karimi, Lisa Passerello, Nita Tallent-Halsell, and Emily Stander (Per Olsson not in photo).

## Ecology Course, from page 2

from the curriculum. Fortunately, the Institute continues to offer its "Fundamentals of Ecosystem Ecology" course every year to help fill this gap for interested students from around the U.S. and beyond. The course's appeal is wider than ever: this January, it attracted two international students (one each from Chile and Sweden) in addition to 15 graduate students from the U.S.

Keeping the two-week intensive course on track, IES ecologist Dr. Gary Lovett coordinated lectures by 14 IES ecologists. With morning and afternoon classroom sessions lasting up to three hours each on topics covering the gamut of ecosystem ecology (including theory, methods, modeling and system characteristics), a final project and a final exam, one might expect students to be overwhelmed. But as Winsor Lowe, a Ph.D. student from Dartmouth College, admitted, the students handled their heavy reading loads, and still managed free time to explore the area on weekends.

While they appreciated the much-needed weekend breaks, students came prepared—and motivated—for two weeks of intensive study. The unique focus of the course, and the expertise IES ecologists bring to their lectures, draw students to the course from far and wide.

Doctoral student Olga Barbosa traveled over 5000 miles, from Santiago, Chile, to participate in this year's course. Faced with no courses in ecosystem ecology at the Catholic University of Santiago, where she is a student, and intending to do her thesis research on ecosystem processes, Olga looked to the course to provide a critical supplement to her education. Her advisor, Dr. Pablo Marquet, and IES adjunct scientist Dr. Juan Arnesto put together the funding to make that possible.

By the end of the course, Olga had learned enough from IES scientists to enable her to work out a clear research project for her thesis. The Institute is already planning the next course for January 2003, and work is underway on yet another contribution to the evolving definition and understanding of the field—a textbook on ecosystem ecology. ●

## New Leadership, New Directions for Continuing Education Program

IES offers more than one hundred adult continuing education courses, lectures, workshops and excursions every year. And while the registration numbers have been encouraging, the new leader of the Continuing Education Program, Richard Wiesenthal, says they have plenty of room to grow.

As Wiesenthal sees it, the Institute's Continuing Education Program is "one of Dutchess County's best kept secrets." But, since his arrival in November 2001, Wiesenthal has been exploring ways to improve the program's visibility. Using his background as the Literacy Coordinator for the Ulster County Board of Cooperative Education Services (BOCES), he is finding ways to introduce the Institute's education program to a larger public audience.

In an attempt to grow the program, and make it available to all area residents, Wiesenthal applied to become an approved service provider for Dutchess Works, a county agency that helps people who are seeking career training. The Institute of Ecosystem Studies is now a recognized trainer, and already has accepted some registrations through this innovative county system.

In addition, Wiesenthal is working to make sure the public-at-large knows about the wide variety of offerings. With features in local newspapers and education industry publications, a strong presence on the internet, and targeted advertising for some specific courses, the Institute's education programs should become more widely known in the Mid-Hudson Valley and beyond.

Wiesenthal also is working to strengthen the Institute's certificate programs and broaden the overall curriculum. He says, "The Institute is very responsive to the needs of students as well as their candid feedback." One recent addition in response to student suggestions is the new 6-week, 20-hour Ecology course (a core course for the newly expanded Gardening Certificate). The winter term course, taught by a team of IES scientists and led by Dr. Alan Berkowitz, garnered praise from students and instructors alike.



*Richard Wiesenthal, IES Program Leader for Continuing Education*

Another exciting development is the opportunity to collaborate with other local service providers. Wiesenthal is joining forces with Dutchess County BOCES to use their research boat for a new program on the Hudson River. He anticipates offering four "River Ecology" excursions this summer. For updates or to register for this and other programs, call Wiesenthal at (845) 677-7000 ext. 319, or visit us online at <http://www.ecostudies.org/education/continuing.html>. ●

## Spring Plant Sale

Flowers and foliage just for you!  
All proceeds benefit the display gardens.  
Come and enjoy!

Friday, May 17: 10 a.m. - 4 p.m.  
Saturday, May 18: 10 a.m. - 4 p.m.  
Sunday, May 19: 11 a.m. - 4 p.m.

## Summer Ecology Day Camp

The 2002 Summer Ecology Day Camp registration is now open! Spaces are available for children entering grades 2 - 7 in the fall of 2002. Campers will spend a week exploring the IES property through ecology experiments, nature study, hiking, crafts and games. Counselor-in-Training positions are available for children entering grades 8 - 12. Call the IES Education Office for more information about the camp at 845-677-7600 ext. 316.





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### Calendar

#### CONTINUING EDUCATION

For information, or to request a catalog, call the Continuing Education office at 845-677-9643 or visit [www.ecostudies.org/education/continuing.html](http://www.ecostudies.org/education/continuing.html). Spring semester programs include:

##### *Gardening*

May 5 (4 sessions): **Garden Design II**

##### *Landscape Design*

Apr. 23 (4 sessions): **Construction II-Site Detailing**

##### *Biology & Ecology*

Apr. 25 (6 sessions): **Plant Pharmacy**

Apr. 28 (2 sessions): **Wild Plant Identification**

May 15: (2 sessions): **Spring Mushrooms**

##### *Lecture Series*

April 15: (4 sessions): **Homeowner's Guide to Organic Landscape Care**

#### SATURDAY ECOLOGY PROGRAMS

Come to **free public programs** on the first Saturday of each month. Children age 6 and up are welcome with an accompanying adult. Pre-registration isn't necessary. If you have questions, call 845-677-7600 ext. 321 for information on upcoming programs:

May 4: Environmental Monitoring at IES, and a Tour of the Weather Station led by IES Research Assistant II Vicky Kelly. Programs are from 1 - 3 p.m. and begin at the Gifford House Visitor and Education Center. [Dress according to the weather for the outdoor programs.]

#### CHILDREN'S PROGRAMS

**IES Ecology Field Programs** for school groups continue throughout the spring months. Teachers may call the Education Office, at 845-677-7600 ext. 316, for information on "Plant Power" (fall, winter and spring, in the greenhouse) or "Water Wonders" (April-June) Fantastic Forests (April-June), Watershed Studies (April-June).

#### IES SEMINARS

Free **scientific seminars** are held at 11 a.m. on Fridays in the Auditorium. Seminars are free, and pre-registration is not necessary.  
Apr. 26: **The spatial pattern of hydrologic controls on nitrogen cycling in forested and urbanizing watershed: an integrated spatially distributed**

**modeling and field sampling approach.** Dr. Christina Tague, San Diego State University..  
May 3: **Linking microorganisms and terrestrial ecosystem functioning: does community composition matter?** Dr. Teri Balser, University of Wisconsin

May 10: **A basin-wide perspective on persistent contaminants in the Hudson.** Dr. Richard Bopp, Rensselaer Polytechnic Institute

May 17: **A Political Scientist's Perspective on George W. Bush.** Fred I. Greenstein, Princeton University.

#### THE ECOLOGY SHOP

**New in the Shop** ...tagua nut figurines, necklaces...birch bark birdhouses...garden thermometers **for children** ...turtle banks...frog umbrellas...tague nut bead kits...**in the Garden Room** ... utility "trugs" from recycled tires...seed somers...garden tool sharpeners...plus many new books for adults and children.

**Senior Citizens Days:** 10% off on Wednesdays

#### GREENHOUSE

The greenhouse is a year-round tropical plant paradise and a site for controlled environmental research. Spring highlights include papaya, banana, lemon, orange, pumelo and kumquat trees. All are producing fruit. The greenhouse is open daily until 3:30 p.m. with a free permit (see HOURS).

#### HOURS

**Summer Hours: April 1 - September 30**

**Public attractions:** Mon.-Sat., 9-6, Sun. 1-6; closed public holidays. The greenhouse closes at 3:30 daily.

**The Ecology Shop:** Mon.-Fri., 11-5, Sat. 9-5, Sun. 1-5. (Please note: The shop is closed Mon.-Sat. from 1-1:30.)

**Free permits are required and are available at the Gifford House Visitor and Education Center until one hour before closing time.**

#### GROUP TOURS

Garden clubs, community groups, student organizations and others can request guided tours of the Gifford Garden, Greenhouse, or Plant Science Building. For information on fees, or to make reservations, call Luanne Panarotti at 845-677-7600 ext. 317.

#### FERN GLEN TOURS

Native Plant Program Assistant Janet Leete leads **free tours of the Fern Glen** on Tuesdays at 11 a.m. and 2 p.m. Pick up your free visitor permit at the Gifford House beforehand (see hours).

#### MEMBERSHIP

Join the Institute of Ecosystem Studies. Benefits include subscription to the newsletter, member's rate for courses and excursions, a 10% discount on IES Ecology Shop purchases, and participation in a reciprocal admissions program. Individual membership: \$40; family membership: \$50. Call the Development Office at 845-677-7600 ext. 120.

#### The Institute's Aldo Leopold Society

In addition to receiving the benefits listed above, members of The Aldo Leopold Society are invited guests at spring and fall IES science updates. Call the Development Office at 845-677-7600 ext. 120.

#### TO CONTACT IES ...

**... for research, graduate opportunities, library and administration:**

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Street address: Plant Science Building,  
65 Sharon Tpke. (Rte. 44A), Millbrook, N.Y.

**... for education, general information and The Ecology Shop:**

Institute of Ecosystem Studies  
Education Program,  
Box R, Millbrook NY 12545-0178  
Tel: 845-677-5359 • Fax: 845-677-6455  
The Ecology Shop: 845-677-7600 ext. 309  
Street address: Gifford House Visitor and Education Center, 181 Sharon Tpke. (Rte. 44A), Millbrook, N.Y.

**... IES website:** [www.ecostudies.org](http://www.ecostudies.org)

For information on current IES public events and attractions, visit: [www.ecostudies.org/welcome/ThisWeek.html](http://www.ecostudies.org/welcome/ThisWeek.html).

For garden tips, follow the link to the Perennial Garden Archives.